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2. Let e =eccentricity. Then $\text{area}=\pi a^2\sqrt{1-e^2}$.

$$\therefore \text{Average area}=\pi a^2 \frac{\int_0^1 \sqrt{1-e^2}}{\int_0^1 de} = \frac{1}{2}\pi^2 a^2 = 2.4674a^2.$$

MISCELLANEOUS.

73. Proposed by CHAS. E. MYERS, Canton, Ohio.

In an ice cream freezer, cream of a homogeneous character and at the uniform temperature of 60° Fahrenheit is put into a cylinder having a closed base, and the whole put into a freezing mixture so as to subject the base and convex surface to a constant temperature of 30° Fahrenheit. Required the temperature at any point within the cream after the expiration of a given time. [From *Higher Mathematics*.]

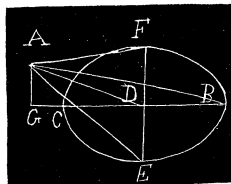
No solution of this problem has been received.

74. Proposed by S. HART WRIGHT, M. D., A. M., Ph. D., Penn Yan, N. Y.

The longest diameter of a horizontal ellipse is $CB=2a=6$ feet. Its shortest diameter is $EF=2b=4$ feet, their intersection being at D . Find in an indefinite vertical plane passing through CB , a point $A=5$ feet= c from D , the ellipse being seen from A as a circle.

I. Solution by the late B. F. BURLESON, and the PROPOSER.

The eye being at A , and the ellipse being projected as a circle, CB and EF subtend equal angles at A , or $\angle EAF=\angle BAC$. Produce DC to G , A being vertically over G , and put $CG=x$, and $GA=y$, and $\angle ADC=\phi$ =angle of elevation of A .



$$\text{Then } y=\sqrt{c^2-(a+x)^2} \dots\dots (1).$$

$$AB=\sqrt{(2a+x)^2+y^2} \dots\dots (\alpha).$$

$$\sin \angle ACG=\sin \angle ACB=y/\sqrt{x^2+y^2} \dots\dots (\beta), \text{ and } \tan \angle EAD=b/c \dots\dots (\gamma).$$

$$\therefore \sin \angle EAF=\sin \angle BAC=2dc/(b^2+c^2) \dots\dots (\delta).$$

From $\triangle BAC$ we have the proportion, $AB : \sin \angle ACB :: BC : \sin \angle BAC$.

$$\therefore \frac{2bc\sqrt{(2a+x)^2+y^2}}{b^2+c^2} = \frac{2ay}{\sqrt{x^2+y^2}} \dots\dots (2).$$

$$\text{Resolving (1) and (2) we have } x=\frac{c\sqrt{(c^4-a^2b^2)(a^2-b^2)}-a}{a(c^2-b^2)}$$

$$=\frac{5}{63}\sqrt{(2945)-3}=1.30697255 \text{ feet.}$$

$$\therefore y=\frac{bc(c^2-a^2)}{a(c^2-b^2)}=2\frac{3}{4} \text{ feet.}$$

$$\phi = \sin^{-1} \left(\frac{b(c^2 - a^2)}{a(c^2 - b^2)} \right) = \sin^{-1} \left(\frac{3}{8} \right) = 30^\circ 31' 35\frac{1}{4}''.$$

II. Solution by J. W. YOUNG, Fellow and Assistant in Mathematics, Ohio State University, Columbus, Ohio.

If the ellipse is seen from A as a circle, $\angle EAF = \angle CAB$. This relation enables us to calculate the coördinates of the point A , in the vertical plane through CB , the origin being at D , and CB being the axis of x .

$$\tan \frac{1}{2} \angle EAF = b/c.$$

Also let $AC = q$ and $AB = p$; $CB = 2a$.

$$\text{Then } \tan \frac{1}{2} \angle CAB = \sqrt{\left(\frac{(s-p)(s-q)}{s(s-2a)} \right)}$$

$$\text{where } s = \frac{1}{2}(p+q+2a).$$

Since $\angle EAF = \angle CAB$, we have, after reducing,

$$\frac{b^2}{c^2} = \frac{4a^2 - (p-q)^2}{(p+q)^2 - 4a^2} \dots \dots (1).$$

Now, since $AD = c$ is the median of $\triangle ABC$, we have by a common trigonometrical formula,

$$2c^2 = p^2 + q^2 - 2a^2 \text{ or } p^2 + q^2 = 2(a^2 + c^2) \dots \dots (2).$$

From equations (1) and (2), we obtain

$$p+q = \pm 2\sqrt{\left(\frac{a^2b^2 - c^4}{b^2 - c^2} \right)}; \quad p-q = \pm 2c\sqrt{\left(\frac{b^2 - a^2}{b^2 - c^2} \right)}.$$

Now, to obtain x and y , we have the relations,

$$(a+x)^2 + y^2 = p^2, \quad (a-x)^2 + y^2 = q^2,$$

$$\text{from which } x = \frac{p^2 - q^2}{4a}.$$

Substituting from above, we have

$$x = \frac{\pm c}{a(b^2 - c^2)} \sqrt{[(a^2b^2 - c^4)(b^2 - a^2)]}, \quad y = \pm \frac{bc(a^2 - c^2)}{a(b^2 - c^2)}.$$

In the special case given, where $a=3$, $b=2$, $c=5$, we have

$$x = \pm 4.31 \text{ feet}, \quad y = \pm 2.54 \text{ feet}.$$

NOTE.—Other solutions of this problem will appear next month.

